Default Values:

Fiber Feeder Pullbox Spacing, feet	
Density Zone	**Distance between pullboxes, ft.**
0-5	2,000
5-100	2,000
100-200	2,000
200-650	2,000
650-850	2,000
850-2,550	2,000
2,550-5,000	2,000
5,000-10,000	2,000
10,000+	2,000

Support: Unlike copper manhole spacing, the spacing for fiber pullboxes is based on the practice of coiling spare fiber (slack) within pullboxes to facilitate repair in the event the cable is cut or otherwise impacted. Fiber feeder pullbox spacing is not a function of the cable reel lengths, but rather a function of length of cable placed. The standard practice during the cable placement process is to provide for 5 percent excess cable to facilitate subsurface relocation, lessen potential damage from impact on cable, or provide for ease of cable splicing when cable is cut or damaged.[24] It is common practice for outside plant engineers to require approximately 2 slack boxes per mile.

3.2.3. Buried Fiber Sheath Addition, per Foot

Definition: The cost of dual sheathing for additional mechanical protection of buried fiber feeder cable.

Default Value:

Buried Fiber Sheath Addition, per foot
$0.20 / ft.

Support: Incremental cost for mechanical sheath protection on fiber optic cable is a constant per foot, rather than the ratio factor used for copper cable, because fiber sheath is approximately ½ inch in diameter, regardless of the number of fiber strands contained in the sheath. The incremental per foot cost was estimated by a team of experienced outside plant experts who have purchased millions of feet of fiber optic cable.

[24] CommScope, *Cable Construction Manual, 4th Edition*, p. 75.

3.3. CABLE SIZING FILL FACTORS

3.3.1. Copper Feeder Cable Sizing Fill Factors

Definition: The spare capacity in a feeder cable, calculated as the ratio of the number of assigned pairs to the total number of available pairs in the cable.

Default Values:

Copper Feeder Cable Sizing Fill Factors	
Density Zone	**Fill Factors**
0-5	.65
5-100	.75
100-200	.80
200-650	.80
650-850	.80
850-2,550	.80
2,550-5,000	.80
5,000-10,000	.80
10,000+	.80

Support: *{NOTE: The discussion in Section 2.6.1. [Distribution] is reproduced here for ease of use.}*

In determining appropriate cable size, an outside plant engineer is more interested in a sufficient number of administrative spares than in the percent fill ratio. The appropriate "target" distribution cable fill factor, therefore, will vary depending upon the size of cable. For example, 75% fill in a 2400 pair cable provides 600 spares. However, 50% spare in a 6 pair cable provides only 3 spares. Since smaller cables are used in lower density zones, Distribution Cable Fill Factors in HM 5.0 are lower in the lowest density zones to account for this effect.

In general, the level of spare capacity provided by default values in HM 5.0 is sufficient to meet current demand plus some amount of growth. Because the model calculates the unit loop investment cost as the total loop investment (including spare capacity), divided by the current loop demand, the resulting unit costs are a conservatively high estimate of the economic cost of meeting current loop demand. This occurs because, in reality, some of the spare copper feeder plant can and will be used to satisfy additional loop demand in the future, without causing any additional investment cost, thus a larger number of customers will pay for the cable over time. In this sense, the HM 5.0 default values for the copper feeder cable sizing fill factors are conservatively low from an economic costing standpoint.

3.3.2. Fiber Feeder Cable Sizing Fill Factor

Definition: Maximum fraction of fiber strands in a cable that are available to be used.

Default Values:

Fiber Feeder Cable Sizing Fill Factor	
Density Zone	**Fill Factor**
0-5	1.00
5-100	1.00
100-200	1.00
200-650	1.00
650-850	1.00
850-2,550	1.00
2,550-5,000	1.00
5,000-10,000	1.00
10,000+	1.00

Support: Standard fiber optic multiplexers operate on 4 fibers. One fiber each is assigned to primary optical transmit, primary optical receive, redundant optical transmit, and redundant optical receive. Since the fiber optic multiplexers used by HM 5.0 have 100 percent redundancy, and do not reuse fibers in the loop, there is no reason to divide the number of fibers needed by a cable sizing fill factor, prior to sizing the fiber cable to the next larger available size.

3.4. CABLE COSTS

3.4.1. Copper Feeder Cable, Cost per Foot

Definition: The investment per foot in copper feeder cable, engineering, installation, and delivery.

Default Values:

Copper Feeder Investment, per foot	
Cable Size	$/foot (u/g & aerial)
4200	$29.00
3600	$26.00
3000	$23.00
2400	$20.00
1800	$16.00
1200	$12.00
900	$10.00
600	$7.75
400	$6.00
200	$4.25
100	$2.50

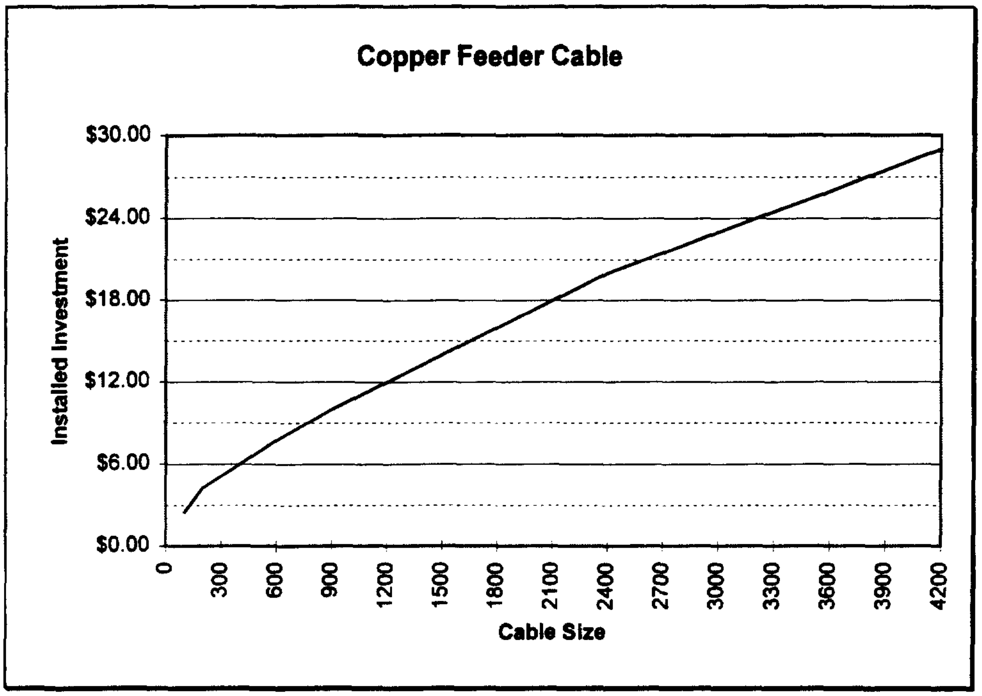
Support: These costs reflect the use of 24-gauge copper feeder cable for cable sizes below 400 pairs, and 26-gauge copper feeder cable for cable sizes of 400 pairs and larger. Although 24-gauge copper is not required for transmission requirements within 18,000 feet of a digital central office with a 1,500 ohm limit, a heavier gauge of copper is used in smaller cable sizes to prevent damage from craft handling wires in pedestals where wires may be exposed, rather than sealed in splice cases. For cables of 400 pairs and larger, splices are normally enclosed in splice cases, and are not subject to wire handling problems.

Cable below 400 Pairs: Outside plant planning engineers commonly assume that the cost of cable material can be represented as an a + bx straight line graph. In fact, Bellcore Planning tools, EFRAP I, EFRAP II, and LEIS:PLAN have the engineer develop such an a + bx equation to represent the cost of cable. As technology, manufacturing methods, and competition have advanced, the price of cable has been reduced. While in the past, the cost of copper cable was typically ($0.50 + $0.01 per pair) per foot, current costs are typically ($0.30 + $0.007 per pair) per foot.

In the opinion of expert outside plant engineers, whose experience includes writing and administering hundreds of outside plant "estimate cases" (large undertakings), material represents approximately 40% of the total installed cost. This is a widely used rule of thumb among outside plant engineers. Such expert opinions were also used to determine that the average engineering content for installed copper cable is 15% of the installed cost. The remaining 45% represents direct labor for placing and splicing cable, exclusive of the cost of splicing block terminals into the cable.

Cable of 400 Pairs and Larger: As copper cable sizes become larger, engineering cost is based more and more on sheath feet, rather than cable size. The same is true for cable placing and splice set-up. Therefore the linear relationship between the number of copper pairs and installed cost is somewhat reduced. A review of many installed cable costs around the country were used by the engineering team to estimate the installed cost of copper cable for sizes of 400 pairs and larger.

The following chart represents the default values used in the model.



3.4.2. Fiber Feeder Cable, Cost per Foot

Definition: The investment per foot in fiber feeder cable, engineering, installation, and delivery.

Default Values:

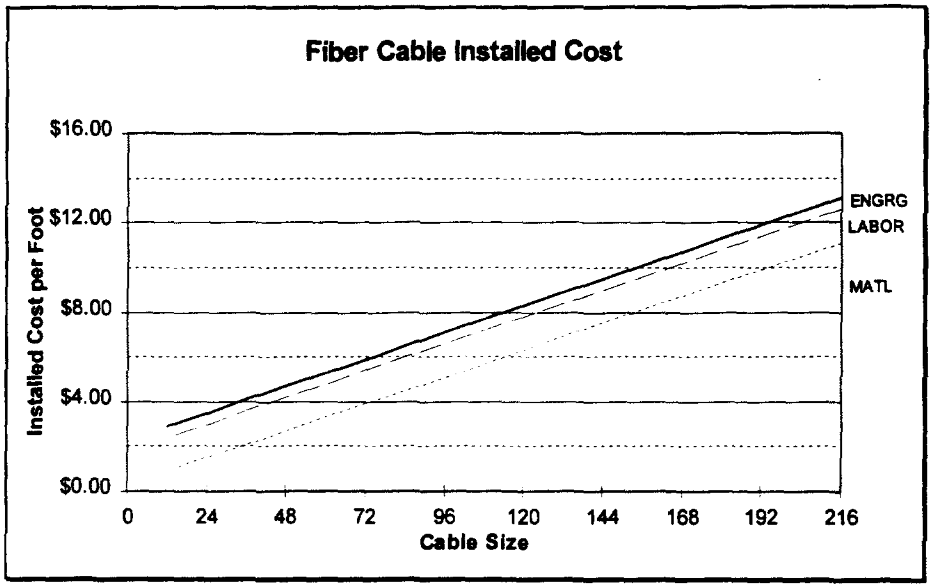
Fiber Feeder Investment, per foot	
Cable Size	**$/foot (u/g & aerial)**
216	$13.10
144	$9.50
96	$7.10
72	$5.90
60	$5.30
48	$4.70
36	$4.10
24	$3.50
18	$3.20
12	$2.90

Support: Outside plant planning engineers commonly assume that the cost of cable material can be represented as an a + bx straight line graph. In fact, Bellcore Planning tools, EFRAP I, EFRAP II, and LEIS:PLAN have the engineer develop such an a + bx equation to represent the cost of cable. As technology, manufacturing methods, and competition have advanced, the price of cable has been reduced. While in the past, the cost of fiber cable was typically ($0.50 + $0.10 per fiber) per foot, current costs are typically ($0.30 + $0.05 per fiber) per foot.

Splicing Engineering and Direct Labor are included in the cost of the Remote Terminal Installations, and the Central Office Installations, since field splicing is unnecessary with fiber cable pulls that are as long as 35,000 feet between splices.

Placing Engineering and Direct Labor are estimated at $2.00 per foot, consisting of $0.50 in engineering per foot, plus $1.50 direct labor per foot. These estimates were provided by a team of Outside Plant Engineering and Construction experts.

The following chart represents the default values used in the model.



3.4.3. Fiber Investment per Strand

Definition: Fiber investment per strand-foot for use in estimating comparative life-cycle costs for copper and fiber feeder. HM5.0 selects copper or fiber feeder cable according to several conditions, one of which is whether copper or fiber (including DLC costs) is cheaper for a given cluster.

Default Value:

Fiber Investment per Strand – foot
$ 0.1000 / fiber- ft.

Support: At the point in the model where a decision is required regarding copper vs. fiber feeder, it is not possible to determine how many fibers will be aggregated along each tapered section of the feeder route. Therefore a design assumption is required to determine how much of the fixed cost of the fiber cable placement and sheath cost is distributed over the number of fibers deployed. This is approximately $0.1000 per fiber strand foot in the model.

3.4.4. Copper Investment per Pair

Definition: Copper investment per pair-foot for use in estimating comparative life-cycle costs for copper and fiber feeder. HM5.0 selects copper or fiber feeder cable according to several conditions, one of which is whether copper or fiber (including DLC costs) is cheaper for a given cluster.

Default Value:

Copper Investment per Pair – foot
$ 0.0075 / pair-ft.

Support: At the point in the model where a decision is required regarding copper vs. fiber feeder, it is not possible to determine how many copper pairs will be aggregated along each tapered section of the feeder route. Therefore a design assumption is required to determine how much of the fixed cost of the copper cable placement and sheath cost is distributed over the number of copper feeder pairs deployed. This is approximately $0.0075 per copper pair foot in the model.

3.5. DLC EQUIPMENT

3.5.1. DLC Site and Power per Remote Terminal

Definition: The investment in site preparation and power for the remote terminal of a Digital Loop Carrier (DLC) system.

Default Values:

Remote Terminal Site and Power	
High Density GR-303 DLC	**Low density GR-303 DLC**
$3,000	$1,300

Support: The incremental per site cost was estimated by a team of outside plant experts with extensive experience in contracting for remote terminal site installations. Low Density DLC cabinets can be mounted on a small 41" x 38" prefabricated concrete or fiberglass pad.

3.5.2. Maximum Line Size per Remote Terminal

Definition: The maximum number of lines supported by the initial line module of a remote terminal.

Default Values:

Maximum Line Increment per Remote Terminal	
High Density GR-303 DLC	**Low density GR-303 DLC**
672	120

Support:

High Density Applications:
The forward looking DLC optimized for high density applications is an integrated NGDLC (Next Generation Digital Loop Carrier) compliant with Bellcore Generic Requirements GR-303, which employs an optical fiber SONET OC-3 transport capable of supporting 2016 full time DS0 POTS time slots. This is a large capacity and highly efficient digital loop carrier for serving the high density environment. While products from different vendors are available in a variety of sizes, HM 5.0 uses typical digital loop carrier remote sizes, which are as follows:

672 DS0s Modeled by HM 5.0 as an Initial Line Increment
1344 DS0s Modeled by HM 5.0 as an Initial Line Increment plus One Additional Increment
2016 DS0s Modeled by HM 5.0 as an Initial Line Increment plus Two Additional Increments

Low Density Applications:
Similar to the high density environment, there are a wide variety of DLC products available for low density applications. These DLC products are NFDLC and are also GR-303 compliant. HM 5.0 uses a 50 Mbps fiber optic based NGDLC that can be configured in a variety of ways (Point-to-Point, Drop and Insert, and Tree Configurations), both as an Integrated Digital Loop Carrier and as a "stand-alone" or Universal Digital Loop Carrier. HM 5.0 utilizes the IDLC configuration. This is a highly efficient digital loop carrier for low density applications. While a variety of sizes are available, the following sizes are used in HM 5.0

120 DS0s Modeled by HM 5.0 as an Initial Line Increment
240 DS0s Modeled by HM 5.0 as an Initial Line Increment plus One Additional Increment

3.5.3. Remote Terminal Fill Factor

Definition: The line unit fill factor in a DLC remote terminal, that is, the ratio of lines served by a DLC remote terminal to the number of line units equipped in the remote terminal.

Default Values:

Remote Terminal Fill Factors	
High Density GR-303 DLC	**Low Density GR-303 DLC**
.90	.90

Support: The most expensive part of integrated digital loop carrier provisioning is the digital to analog conversion that takes place in the Remote Terminal line card. This expensive card (HM5.0 defaults to $310 per 4 line card) calls for stringent inventory control on the part of the ILEC. Also, fill factors are largely a function of the time frame needed to provide incremental additions. Since line cards are a highly portable asset, facility relief can be provided by dispatching a technician with line cards, rather than engaging in a several month long copper cable feeder addition. Therefore high fill rates should be the norm for an efficient provider using forward looking technology.

3.5.4. DLC Initial Common Equipment Investment

Definition: The installed cost of all common equipment and housing in the remote terminal, as well as the fiber optics multiplexer required at the CO end, for the initial line module of the DLC system (assumes integrated digital loop carrier (IDLC) with a GR-303 interface to the local digital switch).

Default Values:

Remote Terminal Initial Common Equipment Investment	
High Density GR-303 DLC	**Low Density GR-303 DLC**
$66,000	$16,000

Support: The cost of an initial increment of Integrated Digital Loop Electronics was estimated by a team of experienced outside plant experts with extensive experience in contracting for remote terminal site installations. Low Density DLC material investments are based on vendor list prices and an estimated 25 percent discount based on large volume purchases.

3.5.5. DLC Channel Unit Investment

Definition: The investment in channel units required in the remote terminal of the DLC system.

Default Values:

GR-303 and low density DLC channel unit investment per unit				
	POTS Channel Unit		Coin Channel Unit	
DLC Type	Channel Card	No. Lines	Channel Card	No. Lines
High Density GR-303	$310	4	$250	2
Low Density GR-303	$600	6	$600	6

Support: The cost of individual POTS Channel Unit Cards was estimated by a team of experienced outside plant experts with extensive experience in contracting for DLC channel units. For the Low Density DLC, the cost is based on vendor list prices and an estimated 25 percent discount based on large volume purchases.

3.5.6. DLC Lines per Channel Unit

Definition: The number of lines that can be supported on a single DLC channel unit.

Default Values:

Lines per Channel Unit		
	POTS Channel Unit	Coin Channel Unit
DLC Type	No. Lines	No. Lines
High Density GR-303	4	2
Low Density GR-303	6	6

Support: This is based on vendor documentation.

3.5.7. Low Density DLC to GR-303 DLC Cutover

Definition: The threshold number of lines served, above which the GR-303 DLC will be used.

Default Value:

Low Density GR-303 DLC to High Density GR-303 DLC Cutover
480 lines

Support: An analysis of initial costs reveals that 2 Low Density DLC units, at 240 lines each, are more cost effective than a single large IDLC unit with a capacity of 672 lines. Beyond two 240 line Low Density DLC units, the larger unit is less costly.

3.5.8. Fiber Strands per Remote Terminal

Definition: The number of fibers connected to each DLC remote terminal, including one for upstream transmission, one for downstream transmission, and two for redundancy.

Default Values:

Fibers per Remote Terminal	
High Density GR-303 DLC	Low density GR-303 DLC
4	4

Support: HM 5.0 assumes a configuration with two main fibers (one for transmit and one for receive) and two protection fibers (one for transmit and one for receive). The protection fibers are equipped and provide transmission redundancy for improved service reliability. The number of fibers required is based on vendor documentation.

3.5.9. Optical Patch Panel

Definition: The investment required for each optical patch panel associated with a DLC remote terminal.

Default Values:

Optical Patch Panel	
High Density GR-303 DLC	Low density GR-303 DLC
$1,000	$1,000

Support: The cost for an installed fiber optic patch panel, including splicing of the fibers to pigtails, was estimated by a team of experienced outside plant experts with extensive experience in contracting for optical patch panels. A fiber optic patch panel contains no electronic, nor moving parts, but allows for the physical cross connection of fiber pigtails.

3.5.10. Copper Feeder Maximum Distance, Feet

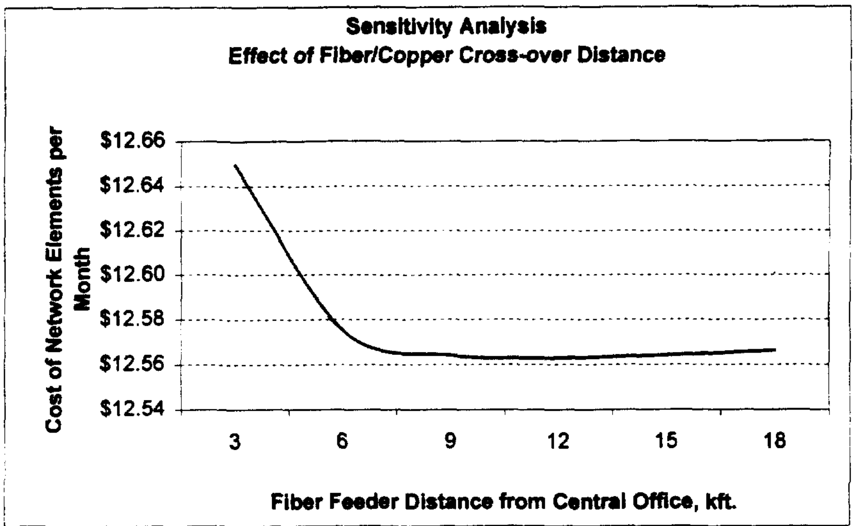
Definition: The feeder length above which fiber feeder cable is used in lieu of copper cable.

Default Value:

Copper Feeder Maximum Distance
9,000 feet

Support: The chart below depicts the result of multiple sensitivity runs of the Hatfield Model, wherein the only variable changed is the copper/fiber maximum distance point. Results indicate that Loop Costs per month drop off as the fiber/copper cross-over distance is increased. This reduction in monthly costs is a function of the investment and maintenance carrying charges for the loop. There is a significant slope from an all fiber feeder at 0 kft. down to 9,000 feet, where the slope becomes essentially flat.

HM 5.0 uses several parameters to determine the need for fiber feeder cable, rather than copper feeder cable. These include 1) assuring that the total copper cable length for both copper feeder and copper distribution do not exceed the threshold value set by default at 18,000 feet; 2)assuring that the copper distribution distance alone does not exceed the threshold value set by default at 18,000 feet; 3) assuring that copper feeder cable does not exceed the Copper Feeder Maximum Distance set by default here at 9,000 feet; and lastly, HM 5.0 tests to see if copper feeder is called for after examining the 3 tests above, whether fiber feeder would have a lower life-cycle cost than copper feeder based on annual carrying charges that include the effects of differences for investment in copper cable vs. fiber cable plus IDLC, depreciation rate differences between technologies, and maintenance cost differences between technologies. If fiber based technology is less expensive, then HM 5.0 will re-compute the copper feeder as fiber feeder.



3.5.11. Common Equipment Investment per Additional Line Increment

Definition: The cost of the common equipment required to add a line module in a remote terminal.

Default Values:

Common Equipment Investment per Additional Line Increment	
High Density GR-303 DLC	Low density GR-303 DLC
672 Line Increment	120 Line Increment
$18,500	$9,400

Support: The cost of an additional increment of Integrated Digital Loop Electronics was estimated by a team of experienced outside plant experts with extensive experience in contracting for remote terminal site installations. Low Density DLC material costs are based on vendor list prices and an estimated 25 percent discount based on large volume purchases.

3.5.12. Maximum Number of Additional Line Modules per Remote Terminal

Definition: The number of line modules (in increments of 672 or 120 lines) that can be added to a remote terminal.

Default Values:

Max. # Add. Line Modules/RT	
High Density GR-303 DLC	Low density GR-303 DLC
2	1

Support: A standard OC-3 multiplexed site can provide 3 OC-1 systems, each at 672 lines. The Hatfield Model allows for adding 2 additional Common Equipment Investment modules to an initial 672 line system, and 1 additional Common Equipment Investment module to an initial 120 line system.

High Density Applications:
While products from different vendors of large NGDLC remotes for high density applications are available in a variety of sizes, HM 5.0 models typical digital loop carrier remote sizes as follows:

672 DS0s Modeled by HM 5.0 as an Initial Line Increment
1344 DS0s Modeled by HM 5.0 as an Initial Line Increment plus One Additional Increment
2016 DS0s[25] Modeled by HM 5.0 as an Initial Line Increment plus Two Additional Increments

Low Density Applications:
Similarly, there are a wide variety of DLC products available for low density applications. The following sizes are modeled in HM 5.0:

120 DS0s Modeled by HM 5.0 as an Initial Line Increment
240 DS0s Modeled by HM 5.0 as an Initial Line Increment plus One Additional Increment

[25] *Note: 2016 line Remote Terminal Cabinets have been available in the market place for some time, and have been observed at field sites by our team of outside plant engineering experts who have taken photographs of sample sites.*

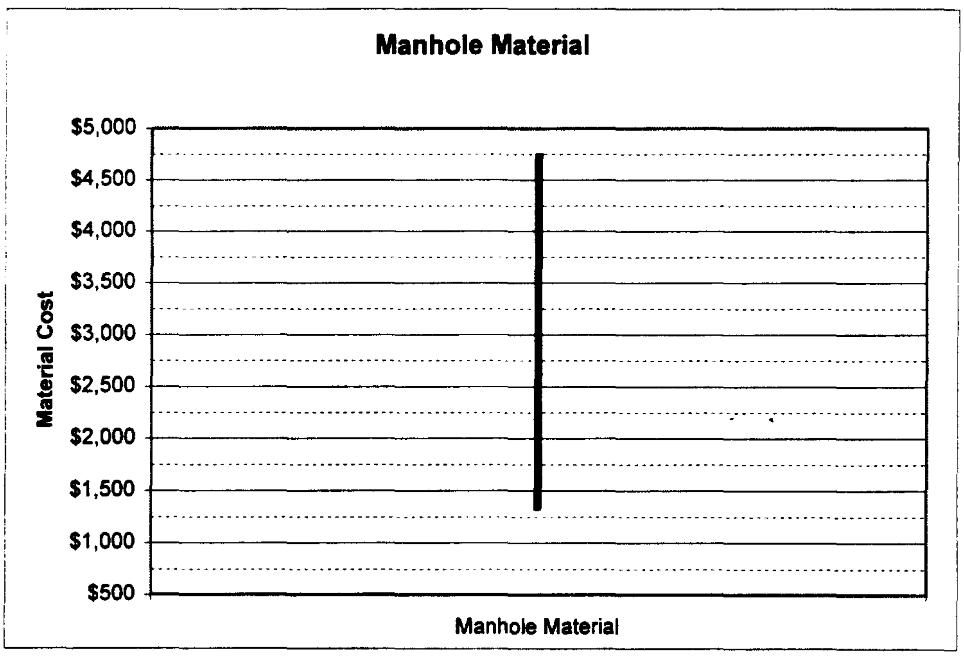
3.6. MANHOLE INVESTMENT – COPPER FEEDER

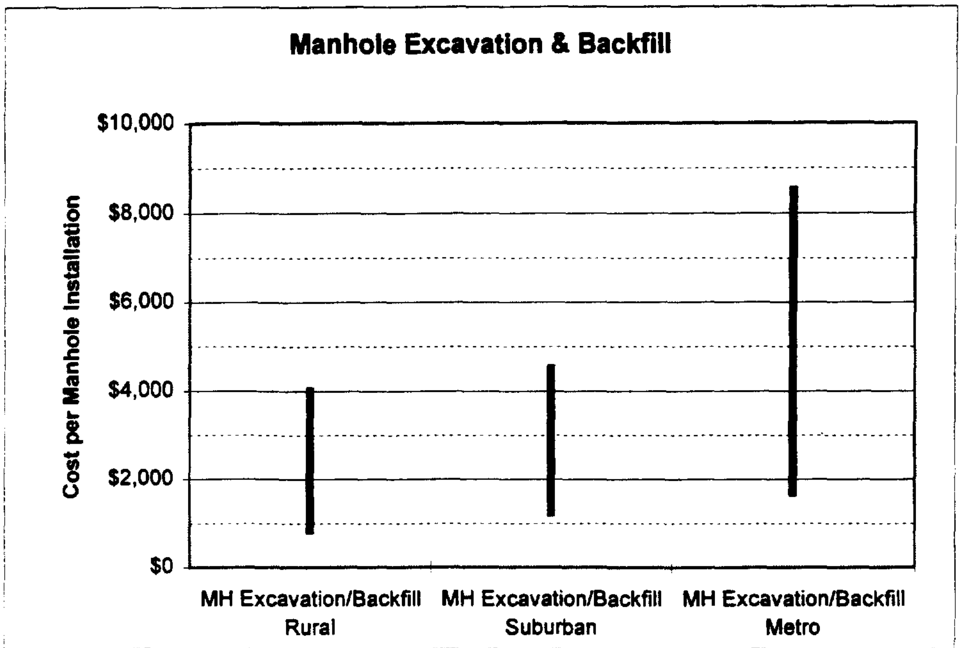
Definition: The installed cost of a prefabricated concrete manhole, including backfill and restoration. All the non-italicized costs in the following table are separately adjustable.

Default Values:

Copper Cable Manhole Investment						
Density Zone	**Materials**	**Frame & Cover**	**Site Delivery**	**Total Material**	**Excavation & Backfill**	**Total Installed Manhole**
0-5	$1,865	$350	$125	*$2,340*	$2,800	*$5,140*
5-100	$1,865	$350	$125	*$2,340*	$2,800	*$5,140*
100-200	$1,865	$350	$125	*$2,340*	$2,800	*$5,140*
200-650	$1,865	$350	$125	*$2,340*	$2,800	*$5,140*
650-850	$1,865	$350	$125	*$2,340*	$3,200	*$5,540*
850-2,550	$1,865	$350	$125	*$2,340*	$3,500	*$5,840*
2,550-5,000	$1,865	$350	$125	*$2,340*	$3,500	*$5,840*
5,000-10,000	$1,865	$350	$125	*$2,340*	$5,000	*$7,340*
10,000+	$1,865	$350	$125	*$2,340*	$5,000	*$7,340*

Support: Costs for various excavation methods were estimated by a team of experienced outside plant experts. Additional information was obtained from printed resources. Still other information was provided by several contractors who routinely perform excavation, conduit, and manhole placement work for telephone companies. Results of those inquiries validated the opinions of outside plant experts and are revealed in the following charts.





3.6.1. Dewatering Factor for Manhole Placement

Definition: Fractional increase in manhole placement to reflect additional cost required to install manholes in presence of shallow water table. Default value is 0.2, indicating that high water tables will increase excavation and restoral cost by 20%.

Default Value:

Dewatering Factor Manhole Investment
0.20

Support: Ground water is not normally a problem with plowing and trenching; it softens the ground and usually does not hinder excavation work. In the rare cases of very wet conditions, contractors simply make sure they always use track vehicles, which is the normal type of equipment used in any case.

Manhole excavation and placement, however, can involve slightly increased costs. In very high water table areas, a concrete manhole will actually tend to float while contractors attempt placement, requiring additional pumping and dewatering during construction work. After the manhole is in place, no additional cost is involved because of water.

3.6.2. Water Table Depth for Dewatering

Definition: Water table depth at which dewatering factor is invoked.

Default Value:

Water Table Depth for Dewatering, ft.
5.00 ft.

Support: Class A manholes are normally placed at a depth of approximately 8 feet. Some residual water is typical. Therefore, a default value of 5 feet is recommended to represent any additional cost incurred to care for high water difficulties in manhole placements.

3.7. PULLBOX INVESTMENT – FIBER FEEDER

Definition: The investment per fiber pullbox in the feeder portion of the network.

Default Values:

Fiber Pullbox Investment		
Density Zone	**Pullbox Materials**	**Pullbox Installation**
0-5	$280	$220
5-100	$280	$220
100-200	$280	$220
200-650	$280	$220
650-850	$280	$220
850-2,550	$280	$220
2,550-5,000	$280	$220
5,000-10,000	$280	$220
10,000+	$280	$220

Support: The information was received from a Vice President of PenCell Corporation at Supercom '96. He stated a price of approximately $280 for one of their larger boxes, without a large corporate purchase discount. Including installation, HM 5.0 uses a default value of $500.

4. SWITCHING AND INTEROFFICE TRANSMISSION PARAMETERS

4.1. END OFFICE SWITCHING

4.1.1. Switch Real-Time Limit, BHCA

Definition: The maximum number of busy hour call attempts (BHCA) a switch can handle. If the model determines that the load on a processor, calculated as the number of busy hour call attempts times the processor feature load multiplier, exceeds the switch real time limit multiplied by the switch maximum processor occupancy, it will add a switch to the wire center.

Default Values:

Switch Real-time limit, BHCA	
Lines Served	**BHCA**
1-1,000	10,000
1,000-10,000	50,000
10,000-40,000	200,000
40,000+	600,000

Support: Industry experience and expertise of HAI. These numbers are well within the range of the BHCA limitations NORTEL supplies in its Web site.[26]

Busy Hour Call Attempt Limits from Northern Telecom Internet Site	
Processor Series	**BHCA**
SuperNode Series 10	200,000
SuperNode Series 20	440,000
SuperNode Series 30	660,000
SuperNode Series 40	800,000
SuperNode Series 50 (RISC)	1,200,000
SuperNode Series 60 (RISC)	1,400,000 (burst mode)

4.1.2. Switch Traffic Limit, BHCCS

Definition: The maximum amount of traffic, measured in hundreds of call seconds (CCS), the switch can carry in the busy hour (BH).

If the model determines that the offered traffic load on an end office switching network exceeds the traffic limit, it will add a switch.

[26] See Northern Telecom's Web site at *http://www.nortel.com*

Default Values:

Lines	Busy Hour CCS
1-1,000	30,000
1,000-10,000	150,000
10,000-40,000	600,000
40,000+	1,800,000

Support: Values selected to be consistent with BHCA limit assuming an average holding time of five minutes.

4.1.3. Switch Maximum Equipped Line Size

Definition: The maximum number of lines plus trunk ports that a typical digital switching machine can support.

Default Value:

Switch Maximum Equipped Line Size
80,000

Support: This is a conservative assumption based on industry common knowledge and the Lucent Technologies web site.[27] The site states that the 5ESS-2000 can provide service for "up to as many as 100,000 lines but can be engineered even larger." The Hatfield Model lowers the 100,000 to 80,000, or 80 percent, recognizing that planners will not typically assume the full capacity of the switch can be used.

4.1.4. Switch Port Administrative Fill

Definition: The percent of lines in a switch that are assigned to subscribers compared to the total equipped lines in a switch.

Default Value:

Switch Port Administrative Fill
0.98

Support: Industry experience and expertise of HAI in conjunction with subject matter experts.

4.1.5. Switch Maximum Processor Occupancy

Definition: The fraction of total capacity (measured in busy hour call attempts, BHCA) an end office switch is allowed to carry before the model adds another switch.

[27] See Lucent's Web site at *http://www.lucent.com/netsys/5ESS/5esswtch.html*

Default Value:

Switch Maximum Processor Occupancy
0.90

Support: Bell Communications Research, *LATA Switching Systems Generic Requirements*, Section 17: Traffic Capacity and Environment, TR-TSY-000517, Issue 3, March 1989, figure 17.5-1, p. 17-24.

4.1.6. MDF/Protector Investment per Line

Definition: The Main Distribution Frame investment, including protector, required to terminate one line. According to Lucent's Web site, a main distribution frame is "a framework used to cross-connect outside plant cable pairs to central office switching equipment, but also carrier facility equipment such as Office Repeater Bays and SLC[R] Carrier Central Office Terminals. The MDF is usually used to provide protection and test access to the outside plant cable pairs."

Default Value:

MDF/Protector Investment per Line
$12.00

Support: This price was obtained by Telecom Visions, Inc., a consulting firm that assisted in the preparation of this Input Portfolio,, from a major manufacturer of MDF frames and protectors. A review of this price with information available in various proceedings indicates that this is a competitive investment cost.

4.1.7. Analog Line Circuit Offset for DLC Lines, per Line

Definition: The reduction in per line switch investment resulting from the fact that line cards are not required in both the switch and remote terminal for DLC-served lines.

Default Value:

Analog Line Circuit Offset for DLC Lines
$5.00 per line

Support: This is a HAI estimate, which is used in lieu of forward looking alternatives from public sources or ILECs. It is based on consultations with AT&T and MCI subject matter experts.

4.1.8. Switch Installation Multiplier

Definition: The telephone company investment in switch engineering and installation activities, expressed as a multiplier of the switch investment.

Default Value:

Switch Installation Multiplier
1.10

Support: The 10% factor used in the Hatfield model was derived based on the following information: Bell Atlantic ONA filing (FCC Docket 92-91) on February 13, 1992, showed a range of engineering factors for the different Bell Atlantic states between .08 and .108. The SBC ONA filing (FCC Docket 92-91) on May 18, 1992, showed a range of engineering and plant labor factors added together between .0879 and .1288. The 10% incremental-based factor is a fairly conservative estimate, given the ranges filed by two RBOCs using traditional ARMIS-based embedded cost factor development.

4.1.9. End Office Switching Investment Constant Term

Definition: The value of the constant ("B") appearing in the function that calculates the per line switching investment as a function of switch line size for an amalgam of host-remote and stand alone switches, expressed separately for BOCs and large independents (ICOs), on the one hand, and for small ICOs, on the other hand. The function is cost per line = A *ln* X + B, where X is the number of lines.

Default Values:

End Office Switching Investment Constant Term	
BOC & Large ICO	Small ICO
$242.73	$416.11

Support: The switching cost surveys were developed using typical per-line prices paid by BOCs, GTE and other independents as reported in the Northern Business Information (NBI) publication, "U.S., Central Office Equipment Market: 1995 Database," compared to switch size and data from the ARMIS 43-07 report.[28]

4.1.10. End Office Switching Investment Slope Term

Definition: The constant multiplying the log function appearing in the EO switching investment function ("A" in the function shown in parameter 4.1.9.) that calculates the per line switching investment as a function of switch line size for an amalgam of host-remote and stand alone switches. This term is the same for BOCs, large independents, and small independents.

Default Value:

EO Switching Investment Slope Term
-14.922

Support: The switching cost surveys were developed using typical per-line prices paid by BOCs, GTE and other independents as reported in the Northern Business Information (NBI) publication, "U.S., Central Office Equipment Market: 1995 Database," compared to switch size and data from the ARMIS 43-07 report.[29]

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[28] Northern Business Information study: *U.S. Central Office Equipment Market – 1995*, McGraw-Hill, New York, 1996.

4.1.11. Processor Feature Loading Multiplier

Definition: The amount by which the load on a processor exceeds the load associated with ordinary telephone calls, due to the presence of vertical features, Centrex, etc., expressed as a multiplier of nominal load.

Default Value: 1.20 for business line percentage up to the variable business penetration rate, increasing linearly above that rate to a final value of 2.00 for 100% business lines.

Support: This is a HAI estimate of the impact of switch features typically utilized by businesses on switch processor load. The assumption is that business lines typically invoke more features and services. Therefore, business lines affect processor real time loading more than residential lines. It is based on consultations with AT&T and MCI subject matter experts.

4.1.12. Business Penetration Ratio

Definition: The ratio of business lines to total switched lines at which the processor feature loading multiplier is assumed to reach the "heavy business" value of 2.

Default Value:

Business Penetration Ratio
0.30

Support: This is a HAI estimate of the point at which the number of business lines will cause the 20 percent processor load addition. It is based on consultations with AT&T and MCI subject matter experts.

4.2. WIRE CENTER

4.2.1. Lot Size, Multiplier of Switch Room Size

Definition: The multiplier of switch room size to arrive at total lot size to accommodate building and parking requirements.

Default Value:

Lot Size, Multiplier of Switch Room Size
2.0

Support: This is a HAI estimate.

4.2.2. Tandem/EO Wire Center Common Factor

Definition: The percentage of tandem switches that are also end office switches. This accounts for the fact that tandems and end offices are often located together, and is employed to avoid double counting of switch common equipment and wire center investment in these instances.

Default Value:

Tandem/EO Wire Center Common Factor
0.4

Support: This is a conservatively low estimate of the number of shared-use switches based on Bellcore's Local Exchange Routing Guide (LERG) data.

4.2.3. Power Investment

Definition: The wire center investment required for rectifiers, battery strings, back-up generators and various distributing frames, as a function of switch line size.

Default Values:

Lines	Investment Required
0	$5,000
1000	$10,000
5000	$20,000
25,000	$50,000
50,000	$250,000

Support: This is a HAI Estimate.

4.2.4. Switch Room Size

Definition: The area in square feet required housing a switch and its related equipment.

Default Values:

Switch Room Size	
Lines	**Sq. Feet of Floor Space Required**
0	500
1,000	1,000
5,000	2,000
25,000	5,000
50,000	10,000

Support: Industry experience and expertise of HAI along with information taken from manufacturer product literature (e.g., Nortel DMS-500 Planner and 5ESS Switch Information Guide). Furthermore, these values are supported by discussions over the years with personnel from LECs and competitive access providers who are familiar with the size of switch rooms through installing switches and/or acquiring space for network switches.

4.2.5. Construction Costs, per Square Foot

Definition: The costs of construction of a wire center building. Although cost per square foot generally decreases as building size increases, the construction cost per square foot is assumed to increase with the number of lines served to account for higher prices typically associated with greater population densities where larger switches tend to be located.

Default Values:

Construction Costs per sq. ft.	
Lines	**Cost/sq. ft.**
0	$75
1,000	$85
5,000	$100
25,000	$125
50,000	$150

Support: This is a HAI estimate.

4.2.6. Land Price, per Square Foot

Definition: The land price associated with a wire center. Land cost per square foot increases with the number of lines served to account for higher prices typically associated with greater population densities where larger switches are located.

Default Values:

Lines	Price/sq. ft.
0	$5.00
1,000	$7.50
5,000	$10.00
25,000	$15.00
50,000	$20.00

Support: This is a HAI estimate.